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GROWING OPTICALLY CLEAR SODIUM NITRATE CRYSTALS

The problem of a supply of a doubly refracting material suitable for the construction of polarizing prisms and other optical parts is an acute one. Calcite has become scarce and material suitable for large polarizing prisms is almost impossible to obtain. Sodium nitrate belongs to the same crystallographic system as calcite and is even more strongly doubly refracting. Hence, it has certain advantages over calcite, but has the minor disadvantages of being rather soft, easily cleaved, and soluble in water.

In 1921 the Bureau experimented with growing sodium nitrate crystals from water solution. It was found necessary to grow the crystal very slowly if striae and inclusions were to be avoided. Several months were needed to grow crystals only about 2 cm on each edge.

More recently, F. B. Phelps and Frederick Bates have grown optical material from the melt. They have found that the crystals grow rapidly in comparison with their development from water solution, larger and clearer crystals being obtained in a few hours than were heretofore obtained in weeks. In fact, an overnight crystallization frequently produces perfectly formed crystals as large or larger than any of the calcite crystals that have been on the market in many years.

Although the apparatus was not designed for the work, satisfactory optical material has been produced, in spite of the fact that the furnace is not of the proper dimensions to give the very small temperature gradient desired. Single crystals have been obtained with the same diameter as that of the container, about 13.5 cm, and about 5 cm in height. In practically every case after the crystal has grown evenly to a thickness of about 2 in. it begins to grow faster up the sides of the container than in the center, forming a deep bowl-like depression. Crystallization then proceeds from the walls in toward the center, resulting in the formation of a number of crystals with distinct boundary lines. This effect is probably produced by the gradient characteristics of the furnace and would disappear if a properly designed furnace were used. The largest crystal so far obtained weighs about 2.5 kg (5 lb).

[1] Published with approval of the Director of the Budget.

PROGRESS REPORT ON INDUSTRIAL USES OF SILVER

Since the item in Technical News Bulletin 249 (January 1938), outlined the general plan of the American Silver Producers' Research Project, the present report will be confined to the status of the project as summarized by the research fellows[2] in their Fifth Progress Report submitted to the sponsors on March 1. It is to be understood that the following observations are based only on this report and are merely tentative, since the work is still in progress and has not been completed in any instance.

Biological action of silver salts.—Physicochemical tests are being conducted to determine, if possible, the mechanism of the reaction between silver salts and proteins, especially those derived from bacteria.

In connection with the toxicological studies, some 600 references have been collected and the records of 240 cases of argyria (silver poisoning) reviewed. This research has shown that, while the indiscriminate and uncontrolled use of silver compounds in humans is wrong and can lead to the development of argyria, it may be tentatively concluded that the reasonable use of silver medically is justified and apparently safe; that it causes no impairment of the general health; that there is no marked individual susceptibility; and that it is probable that the safe dose of silver is the equivalent of about 6 g of the nitrate administered over a long period of time. The physiologic equivalents of other salts have not yet been determined.

The lethal effect of silver on fungus organisms has been demonstrated. One part of silver per million is toxic to organisms in fish hatchery water. The exact silver ion concentration low enough to be harmless to plants or fish yet high enough to be toxic to the organisms that attack plants and cause high mortality in fish hatcheries, remains to be determined. The possibility of using a silver spray solution in viticulture is considered most promising.

Catalytic properties of silver.—The efficacy of silver as a catalyst in the oxidation of ethyl alcohol to acetaldehyde and acetic acid has been studied. The use of samarium-promoted silver in a silver tube, under regulated conditions of operation, was found to give higher conversions and higher total yields than have been reported in the literature.

Heat transfer properties of silver.—An improved apparatus for the study of vapor condensation and heat transfer has been designed. Preliminary data have been obtained with acetone and ethyl alcohol vapors condensing on a silver tube, and drop-wise condensation (as compared to film-type) of these organic vapors has been observed, possibly for the first time.

Physicochemical properties of silver and silver salts.—The properties and utilization of silver compounds, the welding of silver to silver at low temperatures, and the diffusion and absorption of oxygen in silver are under investigation. Calculations based on data in the technical literature have indicated that silver, being permeable with respect to oxygen but not with respect to nitrogen at elevated temperature, could be utilized to fractionate air. The practicability of using this peculiar property to enrich air for blast furnace use is being studied. Similarly, consideration is being given to the use of an oxygen-absorption cycle, taking advantage of the high solubility of oxygen in molten silver and the change of solubility with both pressure and temperature. Other experiments are in progress to determine the conditions of pressure, temperature, and time involved in the "cold-welding" of silver to silver, occasionally encountered industrially. The properties of the sulfide and other salts have been studied, but as yet only to a limited extent.

Electrodeposition of silver and silver alloys.—A procedure has been worked out for the production of thick (0.01 to 0.05 in) adherent deposits of silver on steel. In addition to a direct deposition method, details have been worked out for a process utilizing an intermediate electroplate of a third metal, partic-

[2] University of Pennsylvania Medical School: Chas. A. Zittle, bactericidal action of silver salts; W. R. Hill, toxicological properties of silver. Cornell University: L. W. Nielsen, fungicidal properties of silver compounds. University of Pennsylvania, Towne Scientific School: T. Immediata, catalytic properties of silver; S. J. Wilkins, heat-transfer properties of silver. Lehigh University: G. R. Van Duzee, physicochemical properties of silver and silver salts. Indiana University: L. I. Gilbertson, electrodeposition of silver; A. Johnson, electrodeposition of silver alloys. Rensselaer Polytechnic Institute: D. P. Miles, electrical properties of silver. Battelle Memorial Institute: R. W. Dayton, silver bearing alloys. Massachusetts Institute of Technology: B. S. Old, response of silver allows to heat treatment. Columbia University: V. S. DeMarchi, resistance of silver alloys to corrosion. National Bureau of Standards: A. J. Dornblatt, A. M. Setapen, and T. W. Allen, coordination of project and general metallurgical research.

ularly copper. The relationship between thickness of deposits and imperviousness of the electroplate is being studied.

Nickel, cobalt, cadmium, copper, iron, zinc, and lead have been co-deposited with silver from aqueous solutions, resulting in deposits possessing interesting properties.

Since silver deposits were found to be readily stripped from aluminum cathodes, the latter might serve as starting sheets for the production of films and sheets of silver.

An extensive and annotated bibliography on silver plating has been compiled.

Electrical properties of silver.—The characteristics of sliding silver contacts and silver-graphite brush materials are being studied. Substantial decrease in power losses, and better slip ring and commutator performance are indicated. Automobile starter motor tests are in progress, and the mere substitution of silver-graphite for copper-graphite brushes indicates a gain of 20 percent for the same input. Some advantages indicated are: Lower contact drop; linear current-voltage relation; absence of appreciable polarity effect; and ability to operate at higher current densities. New opportunities for improved design of electrical equipment appear to exist.

Aviation engine bearings.—Studies have shown that alloying silver with another metal results in inferior antifrictional qualities; the best results apparently are obtained with the purest silver. Of a large number of alloying elements studied, only sulfur seemed to produce any improvement, although lead and copper in small amounts were only slightly inferior to pure silver. High thermal conductivity, absence of galling and scoring, and high strength are favorable features of the silver bearing. Tests conducted in a General Motors test machine showed that silver has unusually high load-carrying ability, even with bearings which are very narrow in proportion to their diameter.

Metallurgical studies.—The metallurgical work, because of its extent, has been distributed among several research fellows. Approximately 200 alloys are under investigation, and while definitive appraisal cannot be made at this time, certain trends have been noted. One indication noted is that silver is a surprisingly effective alloy hardener of the solution-forming type, and annealing studies at the Bureau have shown a general tendency of silver in amount of 1 to 5 percent to raise appreciably the annealing temperature of wrought brass, bronze, aluminum bronze, and manganese-silicon bronze.

In addition, interesting aging properties are developed in certain alloys of the following types: Cu-Sn-Ag, Cu-Zn-Ag, Cu-Al-Ag, Ag-Al, Ag-Al-Ti, Cu-Be-Ag, Cu-Ni-Ag, Al-Mg-Ag, Cu-Si-Mn-Ag, Al-Si-Ag, Mg-Zn-Ag, Ag-Cu-Si, Ag-Si, Mg-Sn-Ag. The most promising improvement produced by silver and heat treatment is noted in the tin bronzes, the beryllium bronze where silver replaces some of the beryllium, and the light magnesium-tin alloys. A thorough study is being made of the magnesium-tin alloys with 2.5 percent of silver. Contrary to expectations, the silver-silicon alloys, rich in silver, are notable for their response to heat treatment.

It is believed that the slight solubility of silicon in silver, combined with precipitation hardening properties of alloys containing less than eutectic silicon content, offer a type of alloy that can be used in the chemical and electrical industries to advantage, because of its corrosion resistance, hardness, strength, and relatively high conductivity, both thermal and electrical. Later studies will determine the practicability of adding other elements to improve the general hardness of this type of alloy.

Corrosion tests have shown that (with the exception of certain aluminum and magnesium-base alloys) the addition of up to 1 percent of silver has little if any harmful effect, although generally higher silver up to 5 percent may moderately accelerate corrosion in a brine solution. This seems to apply to brass, bronze, aluminum bronze, beryllium bronze, and cupro-nickels. Up to about 15 percent silver additions reduce the corrosion of zinc.

Some very interesting specimens of silver-iron "alloys" from metal powders, sintered, and worked to sheet have been produced. A silver storage battery, characterized by its ability to take high charge and discharge rates is under investigation. A 10 percent potassium chromate electrolyte has been found advantageous.

Miscellaneous activities.—The senior research associate at the Bureau, A. J. Dornblatt, has personally visited more than 100 industrial and research organizations to acquaint them with the project and exchange data relating to silver.

A list of metallurgical patents relating to silver alloys and to sterilization by silver has been prepared, as well as a list of chemicals and the suitability of silver to withstand their attack.

Through cooperation with an industrial manufacturer of cans, a relatively inexpensive form of solderless silver-lined container, suitable for shipment and storage of pharmaceuticals, chemicals, and possibly foodstuffs, has been developed. Twelve-ounce containers have been produced from silver-clad copper and steel sheets, 0.012 in. thick, with the silver cladding 0.001 in. in thickness, and the development of larger sizes is now in progress.

Since all of the research work being done on the project is "open" and none of it is subject to patent, information on any details of the Silver Research Project can be obtained by writing Mr. Dornblatt at the National Bureau of Standards, Washington, D. C.

ACCURACY OF RADIO-METEOROGRAPH OBSERVATIONS

The radio-meteorograph balloon system which the Bureau has devised for the U. S. Navy Department was described in Technical News Bulletin 250 (February 1938).

In several recent comparisons between radio-meterorograph and aerograph observations, it was noted that the trends of temperature variations as indicated by the two instruments were quite dissimilar. Careful analysis led to the conclusion that the differences were caused by the geographic separation of the two instruments in the air mass and not by errors in their indication. Such effects were noted during an unstable air mass or when strong winds carried the balloon away to a considerable distance from the airplane.

To check this hypothesis, a series of six simultaneous radio-meteorograph, aerograph, and ordinary meteorograph soundings were made. In each test the meteorograph (a recording instrument, recovery of which is required to evaluate the record) was attached to the same balloon as the radio meteorograph. Four of the meteorographs were recovered and three gave complete records. In each case the meteorograph observations agreed faithfully with the radio-meteorograph readings, and both balloon instruments showed the same differences in trend from the aerograph observations. This proves conclusively that there are differences in the character of portions of even a stable air mass, provided they are separated by an appreciable distance.

On the basis of the results of 50 radio-meteorograph and aerograph comparisons and of the 3 radio-meteorograph, aerograph, and ordinary meteorograph comparisons, an estimate of the absolute accuracy of the radio meteorograph can be made. It provides pressure measurements accurate to ±2 millibars (1.5 mm of mercury), temperature readings accurate to ±1° C., and humidity readings accurate to ±5- to 8-percent relative humidity.

WATER AS A REFERENCE STANDARD FOR EBULLIOMETRY

In the Journal of Research for April (RP1088) Wojciech Swiętosławski and Edgar Reynolds Smith discuss the properties of water with reference to its suitability as a primary standard for comparative ebulliometric measurements. The influence of small natural or accidental differences in its isotopic composition with respect to the oxygen as well as to the hydrogen isotopes is shown to be negligible. The equation of Beattie and Blaisdell is suitable for obtaining the boiling point of water to 0.001° or better at any pressure between 660 and 860 mm, and an equation, based on the data of the same authors, is given for obtaining the pressure in an apparatus from the measurement of boiling point.

REFRACTIVE INDEX AND DISPERSION OF DISTILLED WATER

In order to permit the accurate use of distilled water as a standard sample in precision refractometry, Leroy W. Tilton and John K. Taylor have determined the refractive index and dispersion of distilled water for visible radiation, at temperatures from 0 to 60° C. A spectrometer, water-jacketed hollow prisms of nickel, and platinum-resistence thermometers were used in the minimum-deviation measurements. Samples from a continuously operating still were taken on 93 days during a period of 3 years, and observations at 133 temperature–wave-length coordinates were repeated on each of 3 days by each of the authors. All known requisites for precision and accuracy within approximately $\pm 1 \times 10^{-6}$ in index were employed, and the results, which are given in the April number of the Journal of Research (RP1085), are corrected so as to refer to dry air at a pressure of 760 mm Hg and at the temperature of the water.

The data were adjusted by least squares, and are represented by a gen-

eral formula having 13 constants, the average of the 133 residuals being 1.2×10^{-6}. A general double-entry table of refractive indices (6,776 listed values) with temperature and wave length as arguments has been computed to yield sixth-decimal-place data by linear interpolation. More specific tables give indices for the *D* lines of sodium and for 12 other commonly used spectral lines. The maximum refractivity of water is found to be near 0° C, but the exact temperature is a function of the wave length, with a total variation of approximately 0.5° C for the visible special range. Tables and graphs for specific refraction and for partial dispersions are given, and evidences of slight systematic errors are discussed.

The precision of these data is higher than has hitherto been attained but there is marked disagreement (approx. $\pm1\times10^{-4}$) with some of Flatow's indices, which have been widely used and are the basis for the data on water as given in the International Critical Tables. The authors' opinions concerning the accuracy of their results are qualitatively confined by the medial relation of their data to all of those previously published, and quantitatively, within the temperature range 0 to 16° C, there is remarkably close agreement with the interferometerically determined indices of water as reported by Mlle. O. Jasse.

CROSS-CONNECTIONS IN PLUMBING SYSTEMS

In February 1936 an investigation was commenced by Roy B. Hunter, G. E. Golden, and H. N. Eaton of the Bureau's hydraulic laboratory, concerning cross-connections in plumbing systems, with special reference to determining the minimum requirements for the positive prevention of backflow, or backsiphonage, from plumbing fixtures into water-supply pipes. The investigation included a review of the literature on the subject: A study of the influence of structural and service conditions on backflow, and the limits necessary to consider in its prevention; and experimental research on the production of vacua in water-supply systems, and on means of preventing backflow under minimum or limiting conditions. Available existing data were analyzed and correlated with the data from the Bureau's experiments.

RP1086 in the April Journal of Research is a report of the investigation, and contains a brief historical review of past work on the subject, the analysis of conditions in plumbing systems in respect to their maximum or limiting effects in producing backflow, minimum requirements for the prevention of backflow, and a summary and discussion of the conclusions to be drawn from the results of the investigation. For reasons set forth in the report, the conclusions relate only to the technical aspects of the subject, and do not take the form of suggested health or plumbing regulations.

QUICK-DRYING STAMP-PAD INKS

Ink for use with rubber stamps must remain moist on the pad under all atmospheric conditions. In winter, when the air in heated buildings is extremely dry, the ink must not evaporate and leave only a solid residue, while in summer, the humidity should not make it too watery. Glycerin is practically nonvolatile at ordinary temperatures, so the usual kind of stamp-pad ink made by dissolving dye in a mixture of glycerin and water meets the first requirement, that the ink shall not completely evaporate. Unfortunately, glycerin is quite hygroscopic, and for this reason complaint is sometimes made that the pad becomes "juicy" in summer.

The properties of glycerin that make it useful for preparing stamp-pad inks are the very properties that cause trouble when impressions are made on paper with the ink. In winter, when much of the water has evaporated from the pad, the viscous glycerin that stays behind takes a long time to soak into paper. If many papers must be stamped in rapid succession and laid in a pile, it often happens that they become smeared and blurred. In summer, when the air is apt to be of high relative humidity, the layer of ink on the surface of the pad may take up all the water it can, and unless the humidity changes, the ink neither gains more water nor loses what it has. Again, impressions on paper must dry by being absorbed.

Quick-drying stamp-pad inks that contain ethyl acetate, alcohol, or some other readily volatile organic liquid can be bought. These liquids cause the glycerine and water in the ink to soak into paper in a short time, but unfortunately they tend to evaporate from the pad, so that eventually the ink no longer dries quickly. C. E. Waters, of the Bureau's Chemistry Division, has recently developed a stamp-pad ink which penetrates most

kinds of paper so quickly that there is little or no blurring of the impressions when they are rubbed with the fingertips immediately after they are made. A pad placed in the mail and files section of the Bureau was in steady use for 3 months with only one reinking, although the pad box was left open nearly all the time. The ink did not lose its property of drying quickly on paper because the special organic liquid in it is much less volatile than water.

A paper (RP1087) in the April Journal of Research tells how to make the new ink, and gives the results of evaporation tests made on it, on a commercial quick-drying ink that contained ethyl acetate, and on several other mixtures of liquids that might be used for making stamp-pad ink.

DETECTION OF OXIDATION IN WOOL

The susceptibility of wool to deterioration during wet treatments, especially with alkaline reagents, is appreciably increased if the wool has previously been oxidized. Damage resulting from oxidation may be producing during bleaching processes, during processes (such as chlorination and bromination) for producing unshrinkable finishes, and in aging conditions involving exposure to strong light, air, and moisture. Often such damage is not detectable by ordinary physical-testing methods. It may, however, be accentuated during the subsequent processing of the wool. In addition, it has been shown to affect the dyeing properties of the fiber and the durability of woolen materials. The detection of oxidation in wool is, therefore, of considerable importance.

The subject of the effect of oxidizing agents on woolen materials has received much attention during the past few years in a program pertaining to a study of the chemistry of wool. This program is being conducted at the Bureau for the American Association of Textile Chemists and Colorists, with the financial support of the Textile Foundation, Incorporated. In the Journal of Research for April (RP1089), Henry A. Rutherford and Milton Harris describe a new and simple test for the detection of oxidation in wool. The method is based on the ability of oxidized wool to convert a ferrous salt into ferric salt, which in the presence of thiocyanate gives the characteristic red color of ferric thiocyanate.

REACTION OF WOOL WITH HYDROGEN PEROXIDE

The research program on the chemistry of wool, one phase of which was described in the preceding item, has included an extensive study of the effect of oxidizing agents. The results of the work to date have shown that oxidizing agents may cause direct degradation of the fiber or produce incipient damage which becomes apparent only in subsequent wet treatment of the oxidized material. The susceptibility of wool to alkaline reagents is greatly increased by oxidation, and this fact has been utilized in the development of a method for the control of such practical processes as bleaching and chlorination. Such control is especially important since it has been shown that the wearing qualities of wool materials are also related to the extent of oxidation.

The latest work, by Henry A. Rutherford and Milton Harris, which is reported in RP1090 in the April Journal of Research, is an extension of the earlier work and was undertaken to obtain more direct evidence on the nature of the effect of hydrogen peroxide on wool. The results constitute further evidence that the main point of attack of oxidizing agents is the disulfide group of the cystine in wool.

PHOTOCHEMICAL REACTIONS OF WOOL

All textile materials are deteriorated by the action of light, and although wool is one of the most resistant to this type of deterioration, the amount of degradation which may be produced during a long period of time is appreciable. Wool may even be damaged by sunlight while still on the sheep. The strength of the fiber decreases, the dyeing properties are altered, and the felting qualities are reduced. Often, damage produced by light is not apparent until the material is subjected to ordinary wet processes.

In an earlier investigation, a study was made of various factors which influence the rate of deterioration of wool materials by light. The results show that the degradation is accelerated by small amounts of acid but that alkalies act as inhibitors. The authors suggested that in the photochemical deterioration of wool, a portion of the sulfur is converted to hydrogen sulfide, some of which is subsequently oxidized to sulfuric acid. In the Journal of Re-

search for April (RP1091), Milton Harris and Arthur L. Smith describe an apparatus which was developed for the purpose of segregating those reactions and testing the hypothesis. The results obtained with it show that in an atmosphere of purified nitrogen, hydrogen sulfide is evolved from wool during irradiation. In the presence of air the bulk of the hydrogen sulfide is oxidized to sulfuric acid. The rate of evolution of hydrogen sulfide is increased by the presence of moisture. The data suggest that the primary action of the light is an activation of the disulfide group, resulting in a change in the state of the sulfur. A secondary process involving the evolution of hydrogen sulfide from the irradiated wool then occurs. Water does not appear to be essential to the process which involves changing the state of the sulfur, but may play an important part in the secondary reaction.

LIVELINESS OF BASEBALLS

At the request of the Washington Baseball Club, and because of the considerable public interest in the matter, the Bureau recently conducted a series of tests to determine whether or not there is any difference in the liveliness of the ball used by the American League as compared with the ball used by the National League.

The "liveliness," or resilience of a body, is commonly determined by allowing it to fall and rebound from a suitable hard surface. A lively ball rebounds more than a dead ball. However, this method is not satisfactory for baseballs. The principal reason is that the velocity with which the ball leaves the bat in a home run hit is far greater than can be obtained by dropping the ball from any reasonable height. The falling ball is retarded by the resistance of the air and soon approaches a constant speed at which the air resistance equals the weight. This speed has not been accurately determined, but is probably of the order of 120 ft/sec. In any case, large corrections would have to be made for the effects of air resistance in the measurement of liveliness by dropping tests.

As it was necessary to secure impacts comparable with those of a batted ball (because liveliness decreases and deformation of the ball increases in proportion to severity of impact), a machine was constructed at the Bureau which gives relative speeds of the right order of magnitude. The machine which is an adaptation of one developed by Prof. H. A. Thomas, of the Carnegie Institute of Technology, for measuring the liveliness of golf balls, consists of an air gun shooting a 1-lb hardwood projectile (representing the bat) at speeds up to 200 ft/sec against the ball. After impact, the projectile and ball are caught in ballistic pendulums, by means of which their speeds can be determined. The resilience, or "liveliness," is measured by the ratio of the relative speeds after and before impact.

As a result of the Bureau's tests it has been shown that there is no difference of any practical significance between the balls used by the two leagues. Some National League balls are more lively than some American League balls and some are less lively. There are slight variations in liveliness of balls of either league, just as there are slight variations in weight within the official limits of 5 to 5¼ oz and slight variations in circumference within the official limits of 9 to 9¼ in. The differences between averages of three measurements on six balls of each type are small in comparison with variations in the individual measurements and would probably disappear if a very large number of balls were tested.

As a check on the laboratory results, the testing machine was taken to the Washington ball park and used as a robot batter to drive out home runs. It was easily possible to knock the ball over the fence. Numerous measurements of distance were made under the same conditions, insofar as possible. The average distance was the same for the American and National League balls within 1 foot, namely, 367 ft for the conditions used. Individual shots went from 320 to 410 ft, this scatter and lateral deflections up to 30 ft either way being largely due to the effect of the variable wind.

NEW AND REVISED PUBLICATIONS ISSUED DURING MARCH 1938

Journal of Research [3]

Journal of Research of the National Bureau of Standards, volume 20, number 3, March 1938 (RP1078 to RP1084, inclusive). Price 25 cents. Annual subscription, 12 issues, $2.50.

[3] Send orders for publications under this heading only to the Superintendent of Documents, Government Printing Office, Washington, D. C. Subscription to Technical News Bulletin, 50 cents per year; Journal of Research, $2.50 per year (United States and its possessions, and Canada, Cuba, Mexico, Newfoundland, and the Republic of Panama); other countries, 70 cents and $3.25, respectively.

Research Papers [3]

[Reprints from January 1938 issue of Journal of Research]

RP1059. Water tolerances of mixtures of gasoline with ethyl alcohol. Oscar C. Bridgeman and Elizabeth W. Aldrich. Price 5 cents.

RP1060. Critical solution temperatures of mixtures of gasoline, *n*-propyl alcohol, and water. Elizabeth W. Aldrich. Price 5 cents.

RP1061. Interference measurements in the first spectra of neon, argon, and krypton between 4812 and 3319 A. Curtis J. Humphreys. Price 10 cents.

RP1062. Infrared spectra of iron, titanium, and carbon. Carl C. Kiess. Price 5 cents.

RP1063. Consistency of eight types of vitreous enamel frits at and near firing temperatures. William N. Harrison, Robert E. Stephens, and Stephen M. Shelton. Price 10 cents.

RP1064. Some "soft" glazes of low thermal expansion. R. F. Geller, E. N. Bunting, and A. S. Creamer, Price 5 cents.

RP1066. Approximate glass content of commercial portland cement clinker. William Lerch. Price 5 cents.

RP1067. A laboratory extraction apparatus and its use in separating a lubricating-oil fraction with acetic acid. Sylvester T. Schicktanz. Price 5 cents.

RP1068. Volumetric determination of alpha-, beta-, and gamma-cellulose in pulps and in papers containing sizing, filler, and other materials. Herbert F. Launer. Price 5 cents.

Commercial Standards [3]

CS64-37. Walnut veneers. Price 5 cents.

CS65-38. Wool and part-wool fabrics. Price 5 cents.

Technical News Bulletin [3]

Technical News Bulletin 251, March 1938. Price 5 cents. Annual subscription, 50 cents.

[3] Send orders for publications under this heading only to the Superintendent of Documents, Government Printing Office, Washington, D. C. Subscription to Technical News Bulletin, 50 cents per year: Journal of Research, $2.50 per year (United States and its possessions, and Canada, Cuba, Mexico, Newfoundland, and the Republic of Panama); other countries, 70 cents and $3.25, respectively.

MIMEOGRAPHED MATERIAL

Letter Circulars

Letter Circulars are prepared to answer specific inquiries addressed to the National Bureau of Standards and are sent only on request to persons having definite need for the information. The Bureau cannot undertake to supply lists or complete sets of Letter Circulars or to send copies automatically as issued.

LC514. Dampness in masonry walls above grade. (Supersedes LC391.)

LC516. Legibility of ledgers.

RECENT BUREAU ARTICLES APPEARING IN OUTSIDE PUBLICATIONS [4]

A new inch. H. W. Bearce. American Machinist (330 West 42d Street, New York, N. Y.) 82, 181 (March 9, 1938).

Science in crime detection. Wilmer Souder. Proc. Roy. Canadian Inst. (198 College St., Toronto, Canada) series IIIA, 11 (1937).

Degradation of sulfate fiber by bleaching. B. W. Scribner. Paper Industry (333 North Michigan Ave., Chicago, Ill.) 19, 1279 (February 1938).

Computation of heat treatments for whiteware bodies. W. W. Meyer. J. Am. Ceram. Soc. (2525 North High St., Columbus, Ohio) 21, No. 3, 75 (March 1938).

Transverse and compressive strength of building brick. J. W. McBurney. Reprint from Congress Book, International Assn. Testing Materials, Group B—Inorganic materials, Subgroup 3 (28 Victoria St., London, S.W.1, England) 388 (April 19–24, 1937).

American Standard tells how to protect against lightning. M. G. Lloyd. Ind. Standardization and Commercial Standards Monthly (29 West 39th St., New York, N. Y.) 9, 29 (February 1938).

The skeptical physicist. Paul R. Heyl. Sci. Monthly (Grand Central Terminal, New York, N. Y.) 46, 225 (March 1938).

[4] These publications are not obtainable from the Government. Requests should be sent direct to the publishers.

U. S. GOVERNMENT PRINTING OFFICE: 1938